CIR: Fostering Collective Creativity

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Abstract. Nowadays, society and organizations face an accelerated innovation that requires of professionals with new skills and attitudes, especially those related to collective creativity. However, educational environments are slowly integrating emerging paradigms limiting the contribution to the development of key skills related to innovation. Multiple investigations claim that teachers have conservative attitudes toward collaborative schemes, while employers generally recognize the effectiveness of creativity at work. Management of ideas is the core of creativity in innovation processes in the industry and in production and service management. This depends largely on the collective work and individual social skills, as well as on the capabilities that information technology and communication ICT provide. This article presents a process of collective ideas refinement CIR. This process combines paradigms of swarm creativity and social skills as a means to capture the participants' emotions and evaluate the acceptability of ideas. We believe that it is necessary to use new forms of teaching and learning based on swarm creativity paradigms, on individual social skills, and on the use of ICT. Therefore, CIR is a tool that could become an effective way to encourage creativity in individuals.

Keywords: Emotional intelligence · Collective intelligence · Innovation · Creativity · ICT

1 Introduction

The information age confront companies to an accelerated rate of changes where innovation in its products and services is essential to their survival; however, educational environments are slowly integrating emerging paradigms that promote the development of collective creativity. Multiple investigations claim that teachers have conservative attitudes about the effectiveness of collective creativity, while employers generally recognize the effectiveness of creativity in their work. Google, Wikipedia, and Facebook are the best examples of innovation and collective intelligence in action [1].

Creativity currently combines a set of work paradigms, which is not only focused on the individual and on his or her individual creative abilities, but also on the ability to generate an environment of collective intelligence. In this environment, emerging skills

G. Vincenti et al. (Eds.): eLeot 2016, LNICST 180, pp. 145–152, 2017.
DOI: 10.1007/978-3-319-49625-2_18

such as swarm creativity and emotions arise spontaneously allowing the participant to propose solutions without fear of direct criticism from the group, which can be generated in classroom environments (face to face). The use of ICT has proven to be an effective means to mediate creativity in groups, and for this purpose, the group support systems GSS are an effective communication solution in teams of individuals, especially in tasks related to idea generation [2].

This article presents a process of collective ideas refinement CIR, which combines the paradigms of swarm creativity and GSS as a means to capture the ideas and emotions of the participants [3].

2 Literature Review

Intelligence is part of the innate higher cognitive processes, which has allowed to determine the Intellectual Coefficient CI of individuals. According [4] considers three aspects of intelligence: the component element, which refers to the efficiency with which people analyze and process information. Element experience shows how people approach family tasks and the new ones. Finally, the contextual element, which allows to verify how people relate to their environment. In a conventional system where beliefs, traditions, habits and paradigms are everyday part of our society; technology has been incorporated in small portions as a silent body. This gradual and at the same time accelerated process, that technology suggests, has allowed to know the complex world of emotions and its role in the context in which the individual is involved.

(Goleman 1995) through his research has determined that the individual handles two minds, a mind that thinks and a mind that feels. For this reason, the emotional and the rational mind are two relatively independent faculties that reflect the operation of distinct but interrelated brain circuits [5]. This operation has allowed human beings to develop skills that allow them to unconsciously relate to and learn from interaction with other human beings.

The interaction of individuals with others of their kind in the everyday activities and in problem solving shape a space emerging collective intelligence (CI). Pierre Lévy (2010) defines collective intelligence as the ability of human groups to participate in intellectual cooperation in order to create, innovate and invent [6]. Engelbart (1995) states that collective intelligence refers to the measure of the collective capacity of a group, and it should be, in the near future, a key determinant of efficiency with a particular challenge that can be understood and addressed effectively by an organization [16].

Collective intelligence in the field of education has been reported by several authors. According to Gonzalez and Silvana (2012) [7], the vast majority of research in the last decade refers to collective intelligence with the use of technologies. Llon (2012) makes a critique about the educational system, and indicates that teaching is equal to 50 years, while it is not taking advantage of the collective intelligence, which allows the construction of global learning systems, content and networking. It is also maintained that the incorporation of collective intelligence implies not only a technological change or change in the attitude of the teachers, but also an education redefinition [8].

Tsai et al. (2011) [9] indicates that collective intelligence can be used in the teaching-learning process, and that both teachers and students can apply it to content, assessments, and educational materials. For instance, by using the web as a platform. Petreski et al. (2011) reports that there is a change in the approach to instructional design of learning content, allowing to create and share content, opening up new fields of collective intelligence research [10].

A research published by Thompson et al. (2014) [11] indicates that there is evidence that students can be autonomous in their learning and also participate collaboratively. Research carried out by Paus-Hasebrink, Wijnen and Jadin (2010) [12] reported a pilot study to evaluate the Wiki collaborative tool and investigate whether this could be used as a learning tool in schools. The results suggested that the use of this tool can enhance learning and encourage collaborative learning skills. Another study of Matthew, Felvegi and Galloway (2009) [13] applied a methodology that allowed to examine the benefits and challenges of contributing to a wiki; this study was conducted on Language and Literature classes. The results of this research indicate that the Wiki contribution has promoted collaborative processes among students by creating shared knowledge and strengthening the collective knowledge of the group, besides, [17] presented a framework about collective intelligence education.

(Basadur et al. 1982;. Isaksen and Treffinger 1985; Mumford et al. 1991;. Osborn 1957. Parnes et al. 1977) reported by [14], argue that creativity based on problem solving is known as a creative problem solving (CPS) process. According to the literature, CPS is a process of creative problem solving and is formed by the following stages (a) look at the facts, (b) problem formulation, (c) ideas generation, (d) evaluation and selection of the solution and, finally, (e) selection and application. Furthermore [14] they refer to Basadur et al. (2000), and argue that the Group Support Systems GSS could facilitate interaction and improve understanding among team members. According to (Nunamaker et al. 1991) [2] GSS are an effective solution to mediate communication in groups of individuals, especially in areas related to ideas generation.

3 Process of Ideas Collective-Refinement

With the general idea of promoting collective creativity in the educational environment, focused on problem solving, a prototype of GSS and refining process has been designed, developed and formally presented in this section (Fig. 1). The model allows teachers, students and groups, actively participate in the process of creative solution search, through ideas management and assessments according to the participant emotional factors. The archetype facilitates interaction and collaboration of students and groups through an organized refinement process, where in every phase ideas are obtained with greater refinement and acceptance of the participant group.

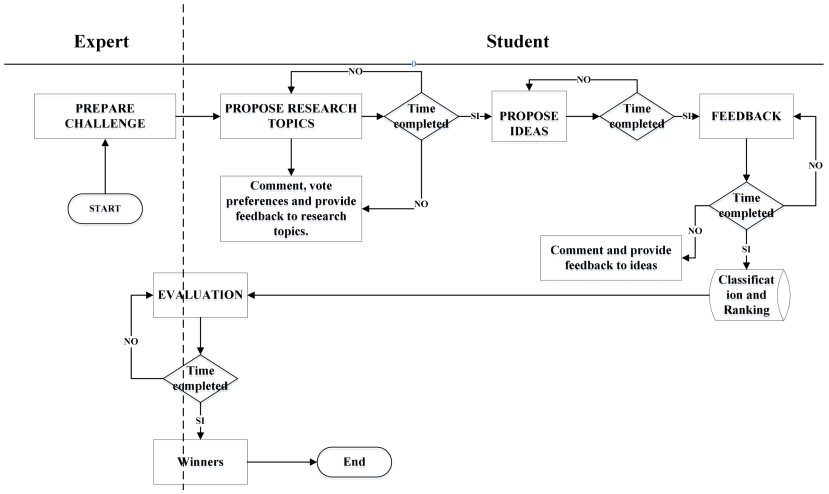

Fig. 1. CIR process

The objective of the proposed model considers the implementation of the GSS as an effective means of ideas refinement to solve a problem through collective creativity.

Figure 1 presents the participation of two actors, experts and students working asynchronously on a set of key activities of CIR. This is summarized in Table 1:

Table 1. CIR key activities

Activity	Description
Prepare Challenge	The expert(s) define an area of general interest (Example: Educational Projects) where it is required to seek for possible problem research areas as well as determine the allocated time for the fulfillment of each of the challenge stages
Topics of Interest	Each one of the participants are enlisted in the suggested challenge and during the assigned time to the challenge, they propose possible topics that present potential problems within the context of the challenge. Each participant in this process can propose as well as to make comments and vote for their preferences on the proposals submitted by other participants, encouraging a constant feedback
Ideas	In one or more topics of interest, even in those proposed by the same participant, solution ideas are prosed to the selected topics. The design of the proposal includes: a title of the solution, a short explanation on how to do it, besides, if required, a short essay of ideas, as well as videos and annexes that support the proposal could be included

(*continued*)

Table 1. (*continued*)

Activity	Description
Feedback	When the phase of ideas is finished, participants come with the first iteration of quantitative refinement. Each participant makes a vote (I like it / I do not like it) on each one of the ideas proposed as a solution, except on the own ones. They can also comment and provide feedback on the proposals of solutions to improve them. Comments include a brief description and, if necessary, a report that includes videos, images, etc. As a result of this process, a ranking of preferences of ideas is generated. The ideas that go to the next stage are classified according to the indicator of preferences ranking PR Table 2
Evaluation	The ideas that exceeded the preference ranking, come to be valued by the / the expert(s) as well as the participants as well as the proponent of the idea. The rating scale is done according to a set of rubrics Table 3. Each item is evaluated by the emotion caused on the evaluator (participant / expert) in accordance to the criteria in Table 4
Winners	Upon completion of the period of time assigned for the assessment, the final ranking of solution proposals is generated for subsequent application; addition, as a result of the refinement process a set of collective work indexes are generated Table 2

Table 2. Rate formula

Rate	Description
Preferences Ranking (RP)	It establishes as valid ideas the ones where the score is among the most voted minus one standard deviation
Final Ranking (RF)	It establishes a winers range which is given in terms of the rubric valuations of the expert(s) X 60 % and students' ratings X 40 %. Only those ideas which punctuation is among the most voted and the most voted minus one standard deviation will be eligible
Preferences Rate	It considers the ratio of the number of received votes by the number of total votes.
Preferences Filtering Rate	It considers the ratio of the number of ideas that reach the RP by the total number of proposed ideas, minus the unit. That is 1 - (RP / # Total Ideas)
Emotional homogeneity Rate	It is the standard deviation of evaluations, this is Average of evaluations ± 1 one standard deviation of evaluations
Similarity Rate	It establishes the similarity ratio of rubrics assessment criteria between the expert(s) and students [18]
Refinement Rate	It considers the ratio of the number of ideas that reach the RF among the total number of proposed ideas, minus the unit. That is 1 - (RF / # Total Ideas)

According to (Battisch, Solomon and Delucchi, 1993; Johnson and Johnson, 2008; Web, 2008) [15], there is some evidence that the effects of cooperative learning achievement depend on social cohesion and the quality of the group. In this sense, the list of indicators (Table 2) are a tool for monitoring levels of cohesion in the group. Therefore, it is maintained that low refinement rates denote groups with scattered criteria. It is also noted that the CIR assessment approach uses emotions as a criterion for assessing the rubrics (Table 3). In this sense, the classification of emotions in positive and negative groups has been considered (Table 4).

Table 3. Rubrics for evaluation

Rubric	Description
Novelty	The thing is new, it exists, it is known or used for a short time
Added Value	The proposal generates added value or contributes to the solution of the problem like never before
Innovation	The presented novelty can become a reality
Inspirer	The proposed content inspires new ideas and it can extend the discussion topic
Appropriate	It is suitable for the solution of the analyzed problem
Complete	The content is complete and it can be easily understood

Table 4. Emotional criteria

Emotion	Description	Group	Value
Dissapointment	I feel a little bad. The proposal is disappointing	Negative	3
Rage	It's terrible. It is the worst proposal I have ever listened about	Negative	1
Anger	There is no effort. It is bad. I do not think it helps to anything	Negative	2
Sadness	It might be better with a little more effort	Negative	4
Joy	I really like it. It makes me happy and I think it could be put into practice	Positive	5
Admiration	It's the best proposal I have ever read. It is excellent	Positive	6

4 Applying CIR Through a Web Tool

In this section, the empirical evidence of CIR application through a web tool is described. CIR was used by three group of student from the University of the Armed Forces of Ecuador ESPE (Table 5) in the academic year 2016.

For each group a challenge was proposed, at the end of the time (Table 5), the students applied a web tool (Fig. 2) for each one of the stages of CIR, at the end of time assigned for resolve the challenge some outcomes about of collective creativity were obtained measured thought the indicator shown in Table 2.

Table 5. Groups of students & empirical experience settings

Degree	Career	Subject of challenge	N	Time
Undergraduate	Early Childhood education	Problems and solution for Early Childhood education	23	15 d
Undergraduate	Science of Physical Activity and Recreation Sports	Physical Activity projects and its influence in the student performance	15	15 d
Posgraduate	Master in University Teaching	Higher education of Ecuador on the future	15	8 d

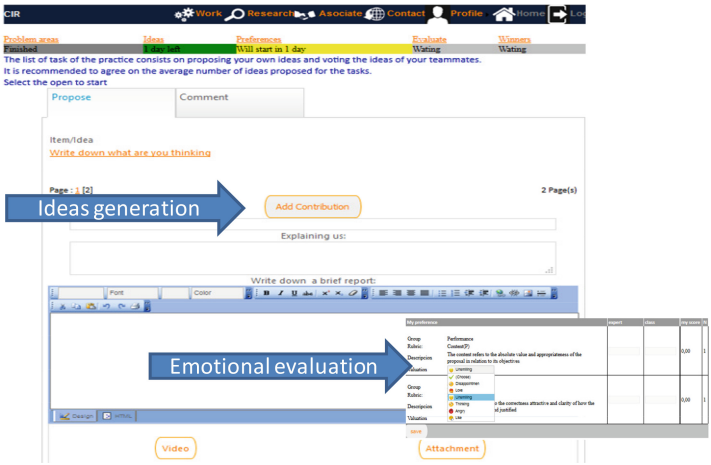

Fig. 2. Main interfaces of the web tool.

5 Conclusions

The objective of the presented work is to share the progress on a research program, which purpose is to provide a process, tools and resources for improving the collective creativity. CIR has a very broad and open conceptual framework and more theoretical and empirical research is necessary to generalize the application of the model.

The inseparable link between body, mind and spirit would help in the formation of a whole human being, using emotional intelligence strategies, collaborative work and ICT's, essential components for his or her formation.

The application of CIR has shown evidence on the usefulness of the model in the development of creative solutions to problems in the educational environment. In addition, the evaluation according to the emotions that generate a proposal on the individual, presents a new field for evaluation in the educational area. The proposed model and the corresponding web tool are the result of a creative combination of theoretical and practical perspectives. From this point, with a consistent model, it will be possible to continue with the development of new features oriented to make recommendations on the continuous improvement to the state of art in the field of collective creativity assisted by a GSS.

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